Model Multimedia Workstation for Echocardiography

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A model multimedia workstation has been developed for echocardiographic laboratory using the Apple Macintosh Quadra 950 system with 8 MBytes of memory, 400 MBytes of disk space, real-time real-color frame grabber, and voice quality audio. Quicktime and Hypercard v.2.1 software were used for the development. The workstation serves as a testing environment for the implementation of video and audio objects in the Echocardiography Information System (EIS) [1]. The EIS consists of a multilayered relational database, graphical user interface, and an intelligent report writer.

Monochrome and true color video including stereo audio channel are digitized in real-time from VHS or S-VHS video tape recorded during routine echocardiographic examination.

The following multimedia objects were modeled: 1) segments of live two-dimensional echo, 2) pairs of still frames for M-Mode, 3) pairs of still frames for continuous wave Doppler echo accompanied with stereo audio, 4) segments of Color Doppler data, and 5) pairs of still frames for contrast echo data. The heart motion within one cardiac cycle is captured in 15-30 frames. Up to 10 different views are obtained during the examination. In M-Mode, a standard 2-D image is captured depicting the location of the M-mode scan line. One page of M-mode data is stored in the other image. Similarly, a position of the Doppler sampling volume is depicted on the first image of the image pair, and one page of Doppler data is recorded as the other image. One cycle of Doppler audio signal is also captured. Color Doppler employs color to superimpose blood flow velocity maps over the tomographic information, and requires real-color performance of the system. For contrast echo, both baseline and contrast frames are stored. In addition, voice annotation for communication among medical staff is also explored in the model situation. The user interface of the model was designed to correspond with the user interface of the EIS.

The model is capable of compressing image data into different formats, including JPEG. The model will therefore allow definition of compression for storage and retrieval of different types of static and dynamic echocardiographic data without loss of clinical information and perceptable degradation of image quality.

The model also revealed that two distinct phases of data management, data entry and review, are necessary. Data entry revolves around the central demand for fast and accurate data capture with minimal need for user interaction in a busy echocardiographic laboratory. Predefined order of distinct views of the heart, on-screen controls of the VCR, and video gating derived from the reference EKG signal will therefore be included in the model. Data review allows the evaluation of stored data in flexible compound displays, arranged to reveal temporal and functional relations in the data, within a patient record and between patients as well. The operator is provided with flexibility and speed to define display formats. The importance of this layer is expected to increase after the echocardiography system is connected to other information systems within cardiology including nuclear, catheterization, and electrophysiology laboratories.

Multimedia capability of the system represents a significant improvement compared to traditional formats, because complete echocardiographic data (text, video, audio, Doppler, color) are stored for a patient with all the benefits of computerized access to them.

Conclusion

The technological sophistication necessary to design and deploy multimedia information systems are now available. The model proved to be a convenient developing and testing environment for a busy clinical echocardiographic laboratory.

Reference:
[1] Sklenar J,Phillips M,Kaul S: A powerful multilayered database for echocardiography laboratory. J Am Coll Cardiol 19:16A, 1992